sentiment, whether conservative or liberal, but from a thorough appreciation of the weight of conflicting evidence. Crawfurd and others notwithstanding, Prof. Whitney assures us that the Malayan, the Polynesian, and the Melanesian languages may henceforth be safely treated as one family, as more closely related, therefore, than Mongolic and Tartaric. One more instance. The Annamese or Cochin Chinese, the Siamese, and the Burmese, whatever their differences, are all alike, we are told, in the capital point, that they are uninflected, and this cannot but be regarded as a strong indication of ultimate relationship. Provisionally, therefore, they are to be classed together as the South-eastern Asiatic, or Monosyllabic Family. All we can say at present is that we hope this is the classification of knowledge, and not of ignorance, and that we shall soon have the *pièces justificatives*, particularly with regard to the Burmese and Siamese. Some new light may also be expected from Prof. Whitney with regard to Chinese, the literature of which, we are told, goes back to 2000 B.C., whatever sceptics may say to the contrary. On all these points our expectations are raised to the highest pitch, and we hope that the professor will soon find leisure to give us not only his conclusions, but the facts on which they are founded. As we said in the beginning, we are disappointed by his present book; we are quite willing, however, to look upon it as a promise, and we have no doubt that the American scholar wil soon redeem the pledges which he has given, and thus not only relieve the science of language from "the incongruities and absurdities" of English, German, and French scholars, but enrich it by truly original American discoveries.

We may point out a few of the inaccuracies as to matters of fact which struck us in the Professor's new book.

Prof. Whitney thinks that *green* may be derived from *to grow*. Is not the root really HAR, and the transition of meaning, to be bright, to be green, to grow (grünen)? See Curtius, *s.v.* χλόη.

Agra, as a Sanskrit word corresponding to ἀγρός, is probably a misprint only. The true Sanskrit word is *Ajra*, field, with the palatal media, whereas *agra* means point.

The nasals are not formed by exit through the nose (p. 63); on the contrary the more we shut the nostrils the more nasal becomes our pronunciation. One of the earliest phoneticians, De Brosses (1709-1778), remarked very truly: "On s'exprime à contre-sens, quand on dit, *parler du nez;* c'est une espèce d'antiphrase: on parlerait du nez si on n'en avait point. S'il est bouché, si l'air n'y passe pas librement, on parlera, on chantera du nez."

The derivation of *luna* from *lucna* (p. 83) is no longer tenable, because we have to take into account the dialectic form *losna*, presupposing an original *loux-na* as in *illustris* for *inluxtris*.

On p. 215, in discussing words like *brother* and *sister*, *bull* and *cow*, *ram* and *ewe*, Prof. Whitney says: "*Man* in its distinctive sense indicates a male animal, and we have a different word, *woman*, for a female of the same kind." The choice of the illustration is not quite happy, considering that *woman*, as is well known to Prof. Whitney, is only a corruption of *wîf-man*.

M. M.

DARWIN ON CARNIVOROUS PLANTS *

II.

Insectivorous Plants. By Charles Darwin, M.A., F.R.S., &c. With Illustrations. (London: J. Murray, 1875.)

IN the Venus's Fly-trap, *Dionæa muscipula* (Fig. 5), we have a further differentiation of the organs of assimilation. The sensibility or irritability resides in three hairs—termed by Mr. Darwin "filaments"—on each half of the upper surface of the bilateral leaf; while the function of absorption appears to belong only to a number of small purplish almost sessile glands which thickly cover the whole of the upper face. These glands have also the power of secretion; but only—and here we have another variation from *Drosera*—when excited by the absorption of nitrogenous matter. The filaments are sensitive both to sudden impact and to contact with other substances, except water; the lobes of the leaf closing together, in the former case very suddenly, in the latter more slowly. If the leaf has closed in consequence of sudden impact or of the contact of non-nitrogenous matter, the two lobes remain concave, enclosing a considerable cavity; shortly re-open in perhaps twenty-four hours; and are at once again irritable. When, however, the irritating foreign substance contains soluble nitrogenous matter, the lobes of the leaf become gradually pressed closely together, and remain closed for a period of many (from nine to twenty-four) days; and when they again open, if they ever do so, are at first scarcely sensitive to renewed irritation. The mode in which (as Mr. Darwin shows) this arrangement is serviceable to the plant by securing the capture of large and permitting the escape of small insects, is highly curious, but too long to quote. The absorption of nitrogenous matter by the glands is accompanied by an aggregation of the protoplasm in the cells of the filaments, similar to that observed in *Drosera*, but this result does not follow the simple irritation of the filaments. The series of experiments described appears to prove the existence of an actual process of digestion in *Dionæa*, the closed leaf forming a temporary stomach, within which the acid secretion is poured out. The plant seems to be subject to dyspepsia, which is even fatal when it has indulged too freely in the pleasures of the table, or rather of the leaf. These observations, however, come from America, where, in its native land, its habits may possibly be more intemperate than in this country. Mr. Darwin believes the motor impulse to be transmitted in *Dionæa* as in *Drosera*, through the parenchymatous tissue of the leaf.

Aldrovanda, an aquatic, perfectly rootless genus, also belonging to the order Droseraceæ, presents phenomena similar to those of *Dionæa*, possessing sensitive hairs which cause the leaf to close, and glands which secrete a digestive fluid and afterwards absorb the digested matter. The order embraces, in addition, only three other genera, *Drosophyllum*, *Roridula*, and *Byblis*, all of which are provided with secreting glands, possessed, in all probability, of similar properties.

When the painful rumour gained circulation, not many months ago, that *Pinguicula* must be added to the list of predatory plants, it was received with even greater incredulity than the stories about *Drosera*. The facts are, however, as patent as in the plants already described.

* Continued from p. 209.

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We have here no sensitive hairs, as in the Droseraceæ. The upper surface of the leaf is studded with glandular hairs of two kinds, one with longish stalks, the other nearly sessile, both of which secrete an extremely viscid fluid; and the dull irritability resides in the blade of the leaf itself,

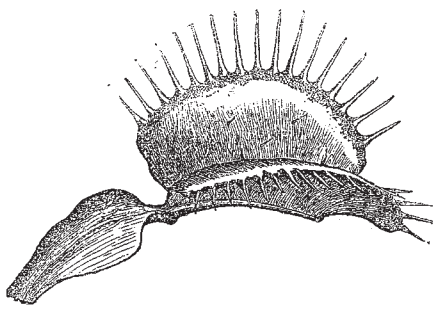

FIG. 5.—*Dionæa muscipula*. Leaf viewed laterally in its expanded state.

which becomes slowly incurved at the margins over substances that excite its sensibility (Fig. 6). This movement of the margin of the leaves (not the apex) is caused either by continued pressure from a foreign solid substance, or by the absorption of nitrogenous matter; water or a solution of sugar or gum produces no curvature; and although the latter, if sufficiently dense, excite a copious increased flow of the viscid secretion, this has no acid reaction. The increased secretion, occasioned by contact of nitrogenous solids or liquids with the glands, is, on the contrary, invariably acid, and possesses the power of rapidly dissolving and digesting insects and other nutrient substances. Some vegetable substances containing nitro-

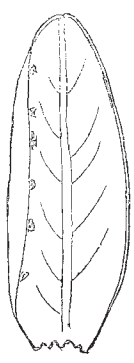

FIG. 6.

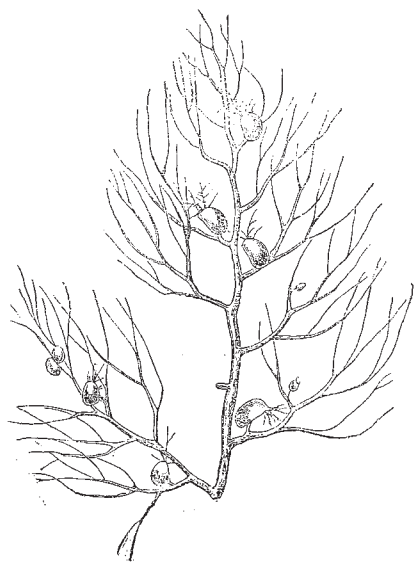

FIG. 7.

Fig. 6.—*Pinguicula vulgaris*. Outline of leaf with left margin inflected over a row of small flies.

Fig. 7.—*Utricularia neglecta*. Branch with the divided leaves bearing bladders; about twice enlarged.

gen, as some seeds and pollen-grains, are acted on in a similar manner, so that the butterwort is a vegetable as well as an animal feeder. The secretion appears to be again absorbed into the glands, together with the nutrient substance dissolved in it.

Until the publication of the present volume, very little was known about the habits of the singular genus *Utricularia* or Bladderwort (Fig. 7), of which several species are natives of ditches, especially of very foul water, in this country. The very finely divided leaves bear a number of minute bladders about one-tenth of an inch in length, the form

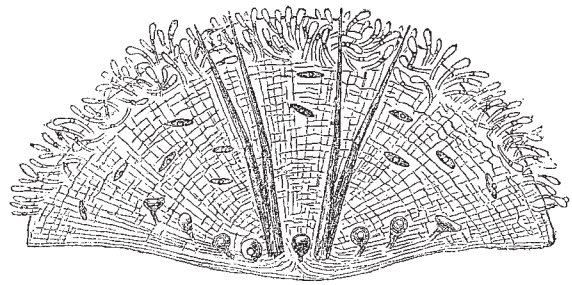

FIG. 8.—*Utricularia neglecta*. Valve of bladder; greatly enlarged.

of which, as Mr. Darwin points out, bears a very singular resemblance to that of a minute Entomostracan Crustacean. Each bladder is furnished near its mouth with two long prolongations, which Mr. Darwin calls "antennæ," branching into a number of pointed bristles. On each side of the entrance to the bladder are also a number of bristles; and the entrance is itself almost entirely closed by a movable valve (Fig. 8), which rests on a rim or collar (the "peristome" of Cohn), dipping deeply into the bladder, and can only open inwards. The surface of

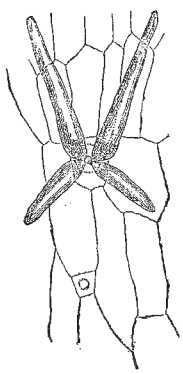

FIG. 9.

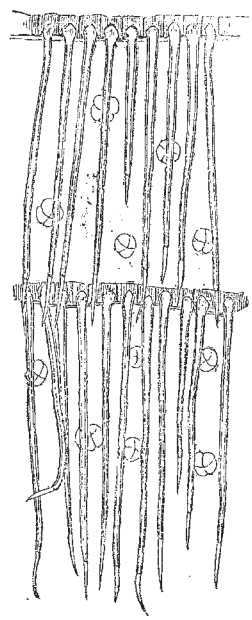

FIG. 10.

Fig. 9.—*Utricularia neglecta*. One of the quadrifid processes greatly enlarged.

Fig. 10.—*Genlisea ornata*. Portion of inside of neck leading into the utricle, greatly enlarged, showing the downward pointed bristles, and small quadrifid cells or processes.

the valve is furnished with a number of glands endowed with the power of absorption, but apparently not of secretion. The whole internal surface of the bladder, with the exception of the valve, is covered with a number of minute bodies—the "quadrifid processes" (Fig. 9)—consisting of four divergent arms of unequal length and grea

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flexibility; the collar itself being furnished with similar but two-armed bodies.

The use of these bladders is not merely, like the air-bladders of *Fucus*, to support the plant in the water; they are employed to capture small aquatic insects and other animals, which they do on a large scale. What it is that attracts the animals to enter the bladders is at present unknown; but, having once entered by pressing down the valve, escape is almost impossible; they sometimes get closely wedged between the valve and the collar, and thus miserably perish. But the most mysterious part of the structure of *Utricularia* is that this beautiful and complicated arrangement for capturing prey is not accompanied by any correspondingly perfect arrangement for its digestion. No secretion whatever has been observed to exude from either the glands or the quadrifid processes; pieces of meat and albumen inserted within the bladders remained absolutely unchanged for three days; and it is only when the bodies of the captured animals begin to decay that the products of decomposition are slowly absorbed by the quadrifid processes; and of even this fact the evidence can only be said to be indirect, depending on a change observed in the appearance of the protoplasmic contents of the cells of the quadrifids and of the glands on the valve and bifids on the collar, similar to that which takes place in the tentacles of *Drosera* during digestion.

The above description is taken from the rare *Utricularia neglecta*, the species first observed by Mr. Darwin; the phenomena are essentially the same in the other British forms. An epiphytic South American species, *U. montana*, bears bladders of a similar structure in all essential points, which capture a quantity of minute animals. This species is also furnished on its rhizomes with a number of small tubers, which appear to serve as reservoirs of water during the dry season. Several other species were examined, including the Brazilian *U. nelumbifolia*, found only in a very remarkable habitat, floating on the water which collects in the bottom of the leaves of a large *Tillandsia* that inhabits abundantly an arid rocky part of the Organ Mountains at an elevation of about 5,000 feet above the level of the sea. In addition to the ordinary propagation by seed, this plant is said to put out runners which are "always found directing themselves towards the nearest *Tillandsia*, when they insert their points into the water and give origin to a new plant, which in its turn sends out another shoot."

It is very curious and suggestive to compare and contrast the contrivances displayed in the two genera, *Pinguicula* and *Utricularia*, belonging to the same natural order. In the latter case we have a most elaborate and perfect contrivance for capturing insects, reminding one of what Mr. Darwin describes elsewhere as "transcending in an incomparable degree the contrivances and adaptations which the most fertile imagination of the most imaginative man could suggest;" but, when the insects are once captured, there is no contrivance for hastening the decay of their tissues, or anything comparable to animal digestion. In *Pinguicula*, on the other hand, the digestive apparatus is most complete; but there is no means whatever of capturing insects, except the very perfectness of the digestive substance itself, the extremely viscid nature of the secretion from the glands. What was the primitive form which has developed into such very diverse structures in these nearly-allied genera? Here we have a problem for the evolutionist to work out; and another for the natural selectionist—what benefit to the plant were these contrivances in their elementary rudimentary stage?—a consideration necessary to the hypothesis of their having been produced by the action of selection. There is a difficulty in conjecturing what use a digestive fluid can have been to the *Pinguicula* before it attained a degree of perfection sufficient to capture insects, or rudimentary bladders to the *Utricularia*, seeing they were not endowed with the power of digestion.

The last genus examined by Mr. Darwin belongs also to the Lentibulariaceæ, the Brazilian *Genlisea*. It is also utriculiferous; but the bladders are of a very different nature to those of *Utricularia*, being simply hollow cavities in the very long petiole or narrow part of the lamina of certain leaves specialised for this purpose. The bladders are not more than $\frac{1}{30}$th of an inch in diameter, and are surmounted by a long tube fifteen times as long and only $\frac{1}{100}$ inch in diameter, which branches at the extremity into two arms coiled in a spiral manner. Very little is known of the habits of the plant, of which only dried specimens have been examined in this country. It is probable that insects creep down the long tube into the bladders, where their remains have been found, and there perish; but whether there is any process of digestion is unknown. The escape of insects once captured is prevented, not by a valve, as in *Utricularia*, but by rows of long thin hairs pointing downwards and springing from ridges which project from the inside of the tube, as shown in fig. 10. The inside of the utricle and of the neck are furnished in addition with a number of quadrifid processes, also represented in the figure, to which the function of absorption is ascribed, and which are compared to the "quadrifids" of *Urticularia*. The drawing of these processes, more than the description, reminds us strongly of certain structures which occur in the leaves of *Drosera* and *Pinguicula*, and which we do not find referred to in the present volume; nor do we know of any description of them elsewhere. Imbedded in the tissue of the leaf of both genera—in the former case often beneath the tentacles—are a number of bodies consisting of four cells and filled with a brown matter; and we cannot but think that attention directed to these bodies may be rewarded by a further insight into the processes of digestion and absorption. They are quite distinct from the papillæ described by Mr. Darwin in the case of *Drosera*. We have seen also analogous structures represented in drawings by Dr. Hooker of either *Nepenthes* or *Sarracenia*; and similar bodies occur in the leaves of some water-plants, as *Callitriche*, to which we are not aware that any function has been assigned.

We have attempted in this notice to introduce our readers only to some of the salient points of Mr. Darwin's researches; and cannot hope to give any idea of the unwearying labour, the precision of the experiments, and the wealth of illustration, for which we must refer all interested in the subject to the volume itself. The novelty of the results arrived at does not lie in the fact of plants being found to feed on organic matter whether animal or vegetable; physiologists have long been familiar with this power in the case of parasites and saprophytes, the

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former deriving their nourishment entirely from living organic matter, in some cases animal, in others vegetable; the latter from organic matter in a state of decay; but neither having the power of "assimilating," or obtaining their food-materials direct from the atmosphere and the inorganic constituents of the soil. *Saprolegnia* and *Cordiceps* are as fully entitled to the designation of carnivorous or even insectivorous plants as *Dionæa* or *Drosera*. The difference lies chiefly in the localisation of the power of absorption, which we have not generally considered to reside in the foliar organs. By far the most interesting facts brought out in this volume—and we think they are amongst the most important published for many years—are the changes from neutral to acid in the nature of the secretion poured out by the glands of Drosera on their excitement by contact with soluble nitrogenous substances; and the alleged "reflex" excitement of the tentacles of *Drosera*. It is impossible to foretell to what these discoveries will lead. We cannot but think that this volume will serve, as the previous ones from the same hand have done, to act as finger-posts to direct future observers in those lines of research which are likely to be the most fruitful and profitable. ALFRED W. BENNETT

OUR BOOK SHELF

Progress-Report upon Geographical and Geological Explorations and Surveys west of the 100th Meridian in 1872, under the direction of Brigadier-General A. A. Humphreys, Chief of Engineers, U.S. Army. By First Lieutenant G. M. Wheeler.—Also *Topographical Atlas to illustrate Geographical Explorations west of the 100th Meridian.* (Washington: Government Printing Office, 1874.)

OUR readers are no doubt aware that a large area of the Western States of America is overrun by a number of expeditions intended mainly for the topographical and geological survey of that immense region. Some idea of the number and constitution of these parties will be obtained from two articles in NATURE, vol. viii. pp. 331 and 385. The "Progress-Report" for 1872 of that under charge of Lieut. G. M. Wheeler contains only brief notes of the work done by the various parties; detailed reports will, no doubt, be published eventually, and will occupy several volumes, besides atlases. The present brief report comprises notes of work done, not only in geology and topography, but also in astronomy, meteorology, natural history, ethnology, and photography. Some idea of the amount of work done may be obtained from the fact that the areas covered topographically during the summer months of 1872 exceeded 50,000 square miles lying in Utah, Nevada, and Arizona. The length of lines in the vicinity of which surveys were made is 6,127 miles, in addition to which other 2,067 miles had to be travelled for various purposes. A large portion of the present publication is occupied with reports on the numerous mining-stations which have been established in the district surveyed, as also on irrigation, agriculture, routes of communication, timber lands, and Indians; from the latter the expedition met with no interference, though of course it was accompanied by a military escort. One of the principal features of this report are the lithographic illustrations from camera-negatives of some of the magnificent cañons on the Colorado River; one of these illustrations gives a fine idea of a rain-sculptured rock at Salt-Creek Cañon, Utah.

The atlas which accompanies this Report is a magnificent work and reflects great credit on the U.S. Government and especially on the topographic section of Lieut. Wheeler's Expedition. Besides a general map, it consists of eight sectional maps in photo-lithography on the scale of one inch to eight miles, sufficiently large to give one an excellent idea of the nature of the country which has been surveyed. The maps are the results of the expeditions under Lieut. Wheeler in the years from 1869 to 1873, and embrace parts of California, Nevada, Utah, and Arizona. Every important feature is shown by characteristic and intelligible signs—mountain ranges, plateaux, cañons, bluffs, hills, craters, salt beds, sands, marshes, rivers, creeks, springs, &c., not to mention artificial features, as roads, trails, railroads, towns, &c. We understand that maps of the whole region west of the 100th meridian are to be published on this scale, and in some cases on a more extended one. It will be a magnificent work when complete, a work of which any country might be proud.

Nach den Victoriafällen des Zambesi. Von Edouard Mohr. 2 vols. (Leipzig: Hirt und Sohn, 1875.)

NOTWITHSTANDING that Herr Mohr went over ground that had been traversed previously, a considerable part of it being included in Livingstone's earlier travels, yet his book contains a great deal that is new and well worth publishing. From the time that he left Bremen in November 1868 till his departure from Africa in the beginning of 1871, the interest of his narrative never flags; the book contains frequent passages of genuine eloquence, quite free from bombast or affectation. During part of his journey, Mohr had as his companion the geologist Adolf Hübner, and their starting-point for the Victoria Falls was Durban. From this point they went almost directly to the falls, Hübner, however, leaving his companion before the Zambesi was reached, in order to visit the recently discovered South African diamond fields. Mohr, as we have indicated, tells the story of his journey and its many interesting incidents, particularly well, although, as might be expected, there were none of the dangers to be encountered which face explorers in less frequented parts of Africa. The book is full of valuable information of all kinds concerning the places touched at or visited both on the voyage out and on the journey from Durban to the Zambesi. The book must be considered as a specially valuable contribution to our knowledge of the natural history and geology, as well as to the geography of the district passed through. To the geographer the narrative will be found of very great value, as it contains a record of the carefully ascertained latitude and longitude of the principal points at which halts were made. Appended is a valuable paper by Hübner on the South African Diamond Fields. The work is illustrated by many good woodcuts and a few brilliant chromo-lithographs. There is also a small but clear map of South Africa, showing not only Mohr's route, but the routes of the principal travellers from Livingstone (1841) downwards. Altogether, the work must be considered a really valuable contribution to our knowledge of the region traversed, and seems to us well worth translating into English.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.*]

Spectroscopic *prévision* of Rain with a High Barometer

THAT the spectroscope should play a part in the prediction of weather for the common purposes of life was an early thought with many; but I have not heard of its resources being very distinctly appealed to in the late series of most memorable μετέωρα of the atmosphere which have passed over this country, setting nearly at naught most other methods of prediction.

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